Full Length Article

# EFFECT OF DHAINCHA AND SUNNHEMP HAY INCORPORATED TOTAL MIXED RATION ON GROWTH PERFORMANCE AND COST EFFECTIVENESS OF MECHERI LAMBS

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## ABSTRACT

*The study evaluated the effect of incorporating dhaincha (Sesbania aculeata) and sunnhemp (Crotalaria juncea) hay in total mixed ration (TMR) on growth performance and cost effectiveness of Mecheri lambs. Twenty-four weaned lambs (3 - 4 months) were allotted to four dietary treatments and fed for 120 days, comprising TMR with 20% hedge lucerne hay (Desmanthus virgatus) as control, 20% dhaincha hay (Sesbania aculeata), 20% sunnhemp hay (Crotalaria juncea), and a combination of 10% dhaincha hay (Sesbania aculeata) + 10% sunnhemp hay (Crotalaria juncea), with all diets formulated to be iso-nitrogenous and iso-caloric and offered ad libitum. Daily feed intake and fortnight body weight were recorded and the economic parameter was calculated at the end of the trial. The results showed no significant differences (P > 0.05) in body weight gain among the treatment groups. Although the dry matter intake was higher in the control group, the legume-based diets were maintained with comparable intake. Economic analysis indicated the lower feed cost and higher net income in lambs fed dhaincha based TMR. The study was concluded that the dhaincha and sunnhemp hay can be used as cost-effective protein-rich alternatives to hedge lucerne hay in TMR based Mecheri lamb production systems.*

**Keywords:** Mecheri lambs, total mixed ration, dhaincha, sunnhemp, cost effectiveness

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## INTRODUCTION

Sheep play a vital role in supporting the livelihoods of small and marginal farmers and landless labourers in India. As per the 20th Livestock Census, the country possesses about 74 million sheep, of which nearly 4.5 million are reared in Tamil Nadu

(DAHD, 2019). Mutton production in India has shown a marked increase from 0.6 million metric tonnes in 2017 (BAHS, 2017) to 1.141 million metric tonnes in 2024, contributing 10.51 per cent to the total meat production (BAHS, 2024). However, per capita meat availability remains low (7.39 kg annum$^{-1}$) compared to the recommended level of 11 kg, highlighting the need for improving sheep productivity (BAHS, 2024).

Mecheri sheep, an indigenous breed of Tamil Nadu, are predominantly reared for meat owing to their higher dressing percentage (54.4%) and superior skin quality, making them economically important in semi-arid regions (DAHD, 2019). Farmers largely depend on the sale of fast-growing lambs attaining higher market weights at an early age. Despite their adaptability to harsh climatic conditions, productivity of Mecheri sheep is often constrained by inadequate nutrition, seasonal scarcity of quality fodder and limited adoption of scientific feeding practices (Usha and Mahesh, 2025).

Strategic nutritional interventions, along with genetic improvement programmes, have been reported to enhance growth performance, feed efficiency and carcass characteristics in indigenous sheep breeds (Chinnathambi and Chitrambigai, 2025; Ebrahim and Alemayehu, 2025). In this context, the utilization of non-conventional fodder resources offers a sustainable solution to overcome feed shortages. Dhaincha (*Sesbania aculeata*) and sunnhemp (*Crotalaria juncea*) are fast growing tropical legumes fodders capable of thriving under adverse soil and climatic conditions and are known for their high protein content, good digestibility and soil fertility improvement through biological nitrogen fixation (Rathika *et al*., 2024).

Total Mixed Ration (TMR) feeding facilitates the efficient utilization of such fodders by ensuring balanced nutrient supply, reducing the selective feeding and improving the nutrient efficiency. Incorporation of dhaincha and sunnhemp hay in TMR can partially replace costly concentrates and improve the dietary protein supply, thereby enhancing the growth performance and economic returns. In this connection, the limited information is available on the nutritive value of these fodders and their effect on growth performance and economics of fattening Mecheri lambs. Hence, the present study was undertaken to evaluate the effect of dhaincha and sunnhemp hay incorporated TMR on growth performance and cost effectiveness in Mecheri lambs.

## MATERIALS AND METHODS

### Experimental location

The present experiment was carried out from March to July, 2025 in the Livestock Farm Complex, Veterinary College and Research Institute, Namakkal, Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), Tamil Nadu, India (78º9’41.11’’E, 11º9’41’’N). The mean maximum temperature was observed from 36.81ºC to 34.89ºC during the experiment period.

**Experimental procedure**

A total of twenty-four weaned lambs aged 3 - 4 months were randomly divided into four dietary treatments groups, each comprising six lambs (three males and three females) as detailed below

| Treatment groups | Number of animals | Details of experiment |
|---|---|---|
| T1 (Control) | 6 | 20 % hedge lucerne (*Desmanthus virgatus*) hay incorporated TMR |
| T2 | 6 | 20 % dhaincha (*Sesbania aculeata*) hay incorporated TMR |
| T3 | 6 | 20 % sunnhemp (*Crotalaria juncea*) hay incorporated TMR |
| T4 | 6 | 10 % dhaincha (*Sesbania aculeata*) hay + 10 % sunnhemp (*Crotalaria juncea*) hay incorporated TMR |

To ensure iso-nitrogenous and iso-caloric diets across all the treatment groups, the proportions of the remaining roughage components, namely sorghum hay (*Sorghum bicolor*) (10 per cent) and kolukattai hay (*Cenchrus ciliaris*) (10 per cent), were appropriately adjusted.

The experimental diets were formulated as a Total Mixed Ration (TMR) to ensure a balanced nutrient intake and to prevent selective feeding by the lambs. All rations were designed to be iso-nitrogenous and iso-caloric (Tables 1 and 2), strictly adhering to the ICAR (2024) nutrient requirements for growing lambs. Throughout the entire experimental period, the Crude Protein (CP) and Total Digestible Nutrients (TDN) were maintained at a fixed level of 16 per cent and 65 per cent, respectively. To achieve these nutritional targets, a constant concentrate to roughage ratio of 60:40 was adopted across all treatment groups. Feed and drinking water were provided ad libitum, with feed allowances adjusted fortnightly based on body weight. The animals were maintained under an intensive system from 4 to 8 months of age under uniform housing and management conditions.

**Growth performance**

All lambs were individually tethered during feeding to record daily feed intake and refusals. Body weights were recorded at the beginning of the experiment and at 15-day intervals before feeding and watering. Fortnightly feed intake was calculated accordingly.

**Cost effectiveness**

The cost of the experimental diets was calculated based on prevailing market prices of individual feed ingredients. Total feed expenditure for each treatment group was obtained by multiplying the quantity of feed consumed by the corresponding feed cost. Feed cost per kilogram of live weight gain was calculated by dividing total feed expenditure by total body weight gain. Net profit was estimated by subtracting the combined costs of feed, initial purchase

value of lambs (at 3 to 4 months of age) and labour from the income obtained through the sale of lambs and meat at the end of the experimental period.

Only variable costs associated with feeding and management were considered in the economic analysis, while fixed costs were excluded since existing institutional housing and facilities were utilized and all animals were sold at the conclusion of the experiment.

**Data analysis**

Data collected from various parameters were subjected to analysis of variance procedures appropriate for a completely randomized design using the SPSS software (version 27.0). The data collected were analysed statistically (One way ANOVA) as per Snedecor and Cochran (1996).

## RESULTS AND DISCUSSION

**Growth performance of Mecheri lambs**

Post-weaned Mecheri lambs fed total mixed rations (TMR) containing dhaincha, sunnhemp or hedge lucerne hay for 120 days exhibited a steady increase in body weight with no significant differences among treatments. Initial body weights were comparable across the groups. Final body weight and total weight gain did not differ significantly ($P > 0.05$) among treatments (Table 3). Final body weight ranged from 25.75 ± 1.22 to 26.23 ± 1.88 kg, while total weight gain ranged from 11.10 ± 0.10 to 11.82 ± 0.07 kg, with the numerically highest gain in the hedge lucerne group (T1). Lambs fed dhaincha (T2), sunnhemp (T3) and their combination (T4) achieved comparable growth, indicating that these legumes can effectively replace hedge lucerne. Similar growth responses have been reported earlier in small ruminants fed dhaincha and sunnhemp (Khan, 1985; Fernandes, 2004; Chandrasekharaiah *et al*., 1996; Dhanunjayudu, 1996; Rachel *et al*., 2017; Min, 2018; Salem *et al*., 2022), while superior growth with lucerne or hedge lucerne has been documented by Malisetty *et al*. (2013) and Aoetpah *et al*. (2024).

Total feed intake was significantly ($P < 0.05$) higher in the control group (103.07 ± 1.22 kg) compared to lambs fed with dhaincha and sunnhemp based TMRs, which recorded lower and comparable intake (95.08 ± 1.07 to 96.24 ± 1.06 kg). Dry matter intake (DMI) increased with advancing age in all groups, with no differences during the first 30 days. Thereafter, the hedge lucerne group showed about 7 - 8 per cent higher intake compared to dhaincha, sunnhemp and mixed legume diets, which may be attributed to better palatability and lower fibre and anti-nutritional factors (Sonawane *et al*., 2019; Malisetty *et al*., 2013). Slightly reduced intake with dhaincha and sunnhemp has also been reported earlier due to the presence of secondary metabolites (Worku *et al*., 2015; Tekliye *et al*., 2018; Farghaly *et al*., 2022). However, the voluntary intake observed in the present study was within acceptable limits and consistent with reports by Reddy *et al*. (2011), Rachel *et al*. (2017), Mohamed *et al.* (2022) and Salem *et al*. (2022). Variations in intake reported

by Mohan *et al*. (1984) and Dhanunjayudu (1996) highlight the influence of forage maturity and inclusion level.

**Cost effectiveness**

The cost-benefit analysis of feeding Mecheri lambs with total mixed rations incorporating sunnhemp and dhaincha hay is presented in Table 3. The initial average body weight of lambs ranged from 14.53 kg in T1 to 14.80 kg in T2, while the final average body weight at the end of the feeding trial varied from 25.75 kg in T4 to 26.23 kg in T2. Total feed consumption per group ranged from 577.02 kg in T4 to 624.06 kg in the control group (T1). The cost per kilogram of feed remained nearly uniform across treatments, ranging from Rs. 17.03 to Rs. 17.79. Consequently, total feed expenditure was highest in the control group (T1; Rs. 11,098.93) and lowest in T4 (Rs. 9,853.49), whereas labour charges (Rs. 2,062.50) and health care expenses (Rs. 120) were identical for all treatment groups. Total expenditure per group ranged from Rs. 40,603.49 in T4 to Rs. 41,621.43 in T1. Total receipts, including the value of animals and manure, varied from Rs. 51,684.87 in T4 to Rs. 52,368.10 in T2, with T2 recording the highest overall returns. Accordingly, net income per group ranged from Rs. 10,580.28 in T1 to Rs. 11,405.22 in T2.

Net income per animal was Rs. 1763.38 ± 334.97, 1900.87 ± 344.43, 1828.90 ± 322.90 and 1835.01 ± 284.87 in T1, T2, T3 and T4 groups respectively. Although lambs fed 20 per cent dhaincha (T2) hay yielded higher net income per animal, the differences among dietary treatments were statistically non-significant. Feed cost per kilogram of live weight gain ranged from Rs. 151.09 ± 12.88 in T2 to Rs. 165.44 ± 15.13 in the control group, with no significant variation observed. The benefit-cost ratio remained favourable across all dietary treatments, ranging from 1.254 to 1.278, indicating profitability under all feeding regimens.

These findings are in agreement with earlier reports on unconventional fodders. Fernandes (2004) observed that feeding 50 per cent dhaincha to Osmanabadi goats reduced feed cost per kilogram gain from Rs. 27.47 (control) to Rs. 26.14, indicating enhanced economic efficiency. Similarly, Chandrasekharaiah *et al*. (1996) reported that subabul leaf meal was more cost effective than sunnhemp hay in Nellore lambs, with feed costs of Rs. 9.20 versus Rs. 9.70 per kg weight gain. Zaki *et al*. (2015) demonstrated that 50 per cent *Sesbania* in lamb diets increased the benefit cost ratio to 3.01 compared to 1.91 in the control, highlighting its profitability. Rachel *et al.* (2017) reported reduced feed cost per animal in Tellicherry kids fed hydroponic sunnhemp (Rs. 130.23), while Gholve, *et al.* (2021) found partial replacement of conventional fodder with *Sesbania* in Osmanabadi goats lowered the feed cost (Rs. 158.36) and increased the net profit (Rs. 2,645.50). Mohamed *et al*. (2022) and Salem *et al*. (2022) further confirmed that inclusion of 30 - 50 per cent *Sesbania* in sheep diets enhanced the net returns and the benefit cost ratios as compared with control, supporting the economic viability of leguminous fodders.

Overall, inclusion of dhaincha and sunnhemp hay, either individually or in combination, did not adversely affect the economic returns in Mecheri lamb production. Notably, incorporation of 20 per cent dhaincha hay in the TMR resulted in the highest improvement in net income per animal (7.8 per cent), followed by the combined dhaincha and sunnhemp hay diet (4.1 per cent) and the sunnhemp hay diet alone (3.7 per cent) compared to the control.

## CONCLUSION

The study revealed that incorporation of dhaincha and sunnhemp hay at 20 per cent level, either individually or in combination, in total mixed ration supported growth performance of Mecheri lambs comparable to hedge lucerne based diets. Although dry matter intake was marginally higher in hedge lucerne fed lambs, it did not result in significant differences in body weight gain. Dhaincha based TMR reduced feed cost and improved net income without affecting productivity. Overall, dhaincha and sunnhemp proved to be nutritionally adequate, economically viable and locally available fodder resources, suitable for inclusion in TMR to reduce feeding cost and enhance profitability in intensive Mecheri lamb production systems.

**Ethical statement:** The procedures in this study were approved by the Institutional Animal Ethical Committee, Veterinary College and Research Institute, Namakkal, TANUVAS, Tamil Nadu.

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## CONFLICT OF INTEREST

There is no conflict of interest among the authors.

**Table.1. Feed ingredients composition (%) of experimental TMR diets**

| Ingredients (%) | T1 | T2 | T3 | T4 |
|---|---|---|---|---|
| Shredded Hedge lucerne hay | **20.00** | 0 | 0 | 0 |
| Shredded Dhaincha hay | 0 | **20.00** | 0 | **10.00** |
| Shredded Sunnhemp hay | 0 | 0 | **20.00** | **10.00** |
| Shredded Sorghum hay | **10.00** | **10.00** | **10.00** | **10.00** |
| Shredded Kolukattai hay | **10.00** | **10.00** | **10.00** | **10.00** |
| Ground Maize (4mm) | 22.15 | 24.34 | 24.55 | 24.45 |
| Ground Soyabean meal (4mm) | 16.26 | 16.52 | 16.86 | 16.69 |
| Ground DORB | 18.98 | 16.54 | 15.99 | 16.27 |
| Salt | 0.5 | 0.5 | 0.5 | 0.5 |
| Sodium bicarbonate | 0.1 | 0.1 | 0.1 | 0.1 |
| Mineral Mixture | 2.0 | 2.0 | 2.0 | 2.0 |
| Vitamin premix | 0.1 | 0.1 | 0.1 | 0.1 |
| Yeast | 0.1 | 0.1 | 0.1 | 0.1 |

**Table.2. Proximate composition (%) of experimental TMR diets**

| Nutrients (%) | T1 | T2 | T3 | T4 |
|---|---|---|---|---|
| Crude protein | 16.57 | 15.75 | 15.84 | 17.03 |
| Crude fibre | 20.83 | 25.62 | 30.80 | 18.10 |
| Crude fat | 2.45 | 2.31 | 2.76 | 2.17 |
| Crude ash | 8.60 | 7.48 | 8.21 | 8.79 |
| Acid insoluble ash | 2.85 | 2.63 | 2.58 | 2.70 |
| Calcium | 0.76 | 0.57 | 0.96 | 0.57 |
| Phosphorus | 0.88 | 0.73 | 0.82 | 0.90 |
| Salt | 0.80 | 0.69 | 0.69 | 0.84 |

**Table.3. Mean (± SE) cost effectiveness of Mecheri lambs fed with dhaincha hay and sunnhemp hay incorporated TMR**

| Particulars | Dietary Groups | | | |
|---|---|---|---|---|
| | T1 (control) | T2 (20% dhaincha hay) | T3 (20% sunnhemp hay) | T4 (10% dhaincha hay + 10% sunnhemp hay) |
| **Expenditure** | | | | |
| Initial weight of the animal kg) | 14.53 ± 1.51 | 14.80 ± 1.09 | 14.75 ± 0.54 | 14.65 ± 0.45 |
| Total weight of six animals(kg) | 87.20 | 88.80 | 88.50 | 87.90 |
| Total value of six animals (Rs.325/kg) | 28340.00 ± 491.58 | 28860.00 ± 353.34 | 28762.50 ± 176.17 | 28567.50 ± 145.04 |
| Cumulative feed intake (kg/ animal) | 103.07b ± 1.22 | 95.58[a] ± 1.08 | 96.24[a] ± 1.06 | 95.08[a] ± 1.07 |
| Cumulative feed intake of six animals | 624.06 | 579.26 | 582.26 | 577.02 |
| **Cost per kg (Rs.)** | **17.79** | **17.13** | **17.03** | **17.08** |
| Total feed cost (Rs.) | 11098.93 | 9920.38 | 9914.23 | 9853.49 |
| Labour wages (Rs.) | 2062.50 | 2062.50 | 2062.50 | 2062.50 |
| Health cover (Rs.20/animal) | 120 | 120 | 120 | 120 |
| **Total expenditure (Rs.)** | **41621.43** | **40962.88** | **40859.23** | **40603.49** |
| **Receipts** | | | | |
| Final weight of the animal (kg) | 26.18 ± 1.39 | 26.23 ± 1.88 | 25.92 ± 1.04 | 25.75 ± 1.22 |
| Total weight of six animals (kg) | 157.10 | 157.40 | 155.50 | 154.50 |
| Overall weight gain (kg/ animal) | 11.82 ± 0.07 | 11.43 ± 0.08 | 11.17 ± 0.10 | 11.10 ± 0.10 |
| Value of six animals (Rs.325/ kg) | 51057.50 ± 452.63 | 51155.00 ± 610.14 | 50537.50 ± 337.27 | 50212.50 ± 397.75 |

| | | | | |
|---|---|---|---|---|
| Value of manure (Rs.2.5/kg) | 1144.21 | 1213.10 | 1295.13 | 1472.37 |
| **Total receipt (Rs.)** | 52201.71 | 52368.10 | 51832.63 | 51684.87 |
| Income | | | | |
| Net income per group (Rs.) | 10580.28 | 11405.22 | 10973.40 | 11081.38 |
| **Net income per animal (Rs.)** | **1763.38 ± 334.97** | **1900.87 ± 344.43** | **1828.90 ± 322.90** | **1835.01 ± 284.87** |
| Benefit Cost Ratio (BCR) | **1.254 ± 0.07** | **1.278 ± 0.05** | **1.269 ± 0.05** | **1.273 ± 0.03** |
| **Feed cost (Rs.) per kg gain** | **165.44 ± 15.13** | **151.09 ± 12.88** | **153.11 ± 11.49** | **152.53 ± 11.45** |

**[a,b,c]Means with different superscripts in the same row differ significantly (P < 0.05)**

**Each value is mean of 6 observations (3 males and 3 females)**

**Cost of ingredients (Rs./kg)**

**Desmanthus hay - 8.00, Kolukattai hay - 2.00, Dhaincha hay - 3.00, Sunnhemp hay - 2.00, Sorghum hay - 4.00, Maize grain - 26.08, Soybean Meal - 35.30, De-Oiled Rice Bran - 13.12, Salt - 9.06, Sodium bicarbonate - 42.16, Mineral mixture - 74.40.**

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